KHRISTIANSEN, G.B.

(2)

31527
S/627/60/002/000/009/027
D299/D305

3,2410(1559, 2705, 2805)

AUTHORS: Vernov, S. N., Goryunov, N. N., Dmitriyev, V. A., Kulikov, G. V., Nechin, Yu. A., and Khristiansen, G. B.

TITLE: Study of high-energy nuclearactive component of extensive air showers at sea level

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959, Trudy. v. 2. Shirokiye atmosfernyye livni i kaskadnyye protsessy, 123-131

TEXT: The high-energy nuclearactive component was studied by the apparatus of Moscow State University. The nuclearactive component was detected and measured by means of hodoscoped counters and ionization chambers. The processed hodoscope data permitted determining the total number of particles N and the distance R_i of the shower axis from the ionization chambers. Part of the data were processed by the electronic computer of Moscow State University; thereby the number of particles was determined to an accuracy of approximately

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20%, and the position of the axis to within 0.25 m, provided it fell inside the area of a detector of 4 m². The joint processing of the data of the hodoscope and ionization chambers yielded the mean energy of the nuclearactive component of showers of various number of particles, the energy spectra of the nuclearactive particles in the central part of the shower, the lateral distribution of the energy flux carried by the nuclearactive component in the central part of the shower and the lateral distribution of the nuclearactive particles. Showers, whose axes were at a distance of less than 10 m from the detector of nuclearactive particles, were selected for further study. These showers were divided into 4 groups according to number of particles; over 1000 such showers were investigated. The integral spectra of nuclearactive particles of energies $E_{na} \leqslant 10^{12}$ ev. were obtained for the 4 groups. The integral spectra of nuclearactive particles, averaged over the showers of all the groups, can be approximated by an exponential function with exponent $\gamma = -1.0 \pm 0.2$. For showers with large N (group 4), the value of γ shows a decreasing tendency. The space distribution of the energy flux near the

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axis can be approximated by an exponential function with exponent
$n = -1.5 \pm 0.2$. A typical correlation was established between the
electron-photon and the nuclearactive components of cores of the in-
dividual showers, namely showers with an electron-photon component
of an energy much higher than the average, have (as a rule) a nu-
clearactive component of lesser energy. The converse was also ob-
served. The measurements gave direct evidence of the presence of nu-
clearactive particles of high-energy ($\sim 10^{12}$ ev.) in showers at sea
level, and of the considerable importance of the nuclearactive com-
ponent in the energy balance of the shower. The nuclearactive com-
ponent in the central part of the shower carries an energy which is
(on the average) almost as large as the entire energy of the elec-
tron-photon component at the level of observation. The presence of
considerable energy in the nuclearactive component affects the ab-
sorption of particles in the shower. The development of individual
showers can differ considerably, as the magnitude of the energy of
the nuclearactive component differs considerably in the individual
showers. The main contribution to the energy flux carried by the nu-

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clearactive component within a circle of given radius is made by
high-energy particles, whose lateral distribution is such that, on
the average, all the particles with energy $>10^{12}$ ev. are contained
in a circle of radius $r = 1$ m. The distribution of the energy flux
carried by the nuclearactive component showed that this flux is
fairly widely distributed. Further, the transverse momentum im-
parted to the particles (during their generation), was estimated.
The nuclearactive component of showers with $N = 10^4$ to 10^6 at sea
level carries an energy of 0.5 to 1.0 of the total energy, carried
by the electron-photon component. As a result of the energy fluctu-
ations of the nuclearactive component in the individual showers, the
development of the showers fluctuates, too. The distribution of the
energy flux of the nuclearactive component over a region of $1 < r < 20$ m
near the axis is described by the law $r^{-2\pm0.25}$; such a distribution
should affect the characteristics of the soft component. There are
4 figures, 1 table and 10 references: 9 Soviet-bloc and 1 non-So-
viet-bloc. The reference to the English-language publication reads
as follows: J. Nishimura, K. Kamanta.Suppl. Prog.Phys.,no.6, 1958.

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S/627/60/002/000/016/027
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3.2410 (1105, 2705, 2905)

AUTHORS: Vernov, S. N., Tulupov, V. I., Khrenov, B. A., and
            Khristiansen, G. B.

TITLE: Investigating high-energy /μ-meson component of exten-
            sive air showers

SOURCE: International Conference on Cosmic Radiation. Moscow,
            1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kas-
            kadnyye protsessy, 169-180

TEXT: The selection of /μ-mesons of various energies was carried
out by recording them at various depths of the absorber. The pecu-
liar feature of the experiments consisted in the need to select
showers, whose axes pass at various distances from the meson det-
ectors, so as to study the space distribution of the meson flow.
Thereby, the distance between the underground detectors and the
shower axis recorded at the surface, may largely depend on the in-
clination of the shower axis. The apparatus made it possible to
determine the mean density of meson flow with treshold energies

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E_μ equal to 0.4, 5, and 10 Bev, at distances of 100, 25, and below 25 m, for showers of various number of particles. The detectors with a large sensitive area permitted observing the peculiarities of meson distribution in the various showers. The apparatus was in operation for approximately 2000 hours. The energy spectra of the μ-mesons and their lateral distribution for distances of 3 - 100 m from the shower axis were obtained. It was found that for showers with $N = 2 \cdot 10^5$, the lateral distribution of μ-mesons with $E_\mu \geqslant 10$ Bev has an exponent $n \leqslant 1$ for distances up to 100 m. This means that μ-mesons of such energies are mainly found outside a circle of radius $r = 100$ m. Further, the irregularities of meson-distribution at a depth of 40 m were studied in individual showers by means of meson detectors of total area 3.1 m^2. Irregularly distributed meson-groups were observed. In all, 17 such groups were recorded in 14 showers, during 800 hours of operation of the detectors. The pertinent experimental results are listed in tables. It was found that the meson groups appear in showers which do not differ from "aver-

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age" showers with respect to the total meson-flow. The distance be-
tween the meson group and the shower axis did not exceed 3 m for

showers with $N = 2 \cdot 10^5$. A comprehensive knowledge of the high-ener-
gy meson component was obtained, in particular with respect to me-
son flow in the vicinity of the shower axis, where the energy of
the μ-mesons exceeds 10 Bev. By comparing the number of mesons at
mountain altitude and at sea level, the conclusion is reached that
μ-mesons with $E_\mu > 10$ Bev. are effectively generated at high altitudes
(above 3800 m), acquiring a sufficiently large transverse momentum.
The character of the lateral distribution of μ-mesons near the
shower axis is determined by the character of meson generation ac-
cording to altitude. Computations were carried out of meson distri-
bution near the axis ($r < 25$m), with $E_\mu > 10$ Bev, for 2 models of ex-
tensive shower development. Further, various interpretations are
proposed for the appearance of μ-meson groups in the vicinity of
the shower axis. The angular distribution of π-mesons in nuclear
interactions has a substantial effect on the lateral distribution
of μ-mesons with $E_\mu > 10$ Bev. The majority of μ-mesons of such ener-
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gies are generated at altitudes of 6 - 8 km above sea level. The dependence of the number of μ-mesons with $E_\mu > 10$ Bev. on the number of particles in the shower, in the circle $r = 25$ m, is expressed by $N^{0.6 \pm 0.1}$ (for the range $N = 10^4$ to $5 \cdot 10^5$). The meson distribution (with $E_\mu > 10$ Bev.) in showers with $N = 2 \cdot 10^5$ is expressed by $\rho_\mu = K/r^n$, $n = 0.8 \pm 0.2$, for distances of 3 to 10 m from the shower axis. There are 5 figures, 6 tables and 10 references: 8 Soviet-bloc and 2 non-Soviet-bloc. The references to the English-language publications read as follows: B. Edwards, J. Losty, D. H. Perkins, P. Pinkau, J. Reynolds. Phil. Mag., 3, 237, 1958; A. Ueda, N. Ogita. Progr. Theor. Phys., 18, 269, 1957.

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SOV/56-36-3-4/71

21(7)
AUTHORS: Vernov, S. N., Goryunov, N. N., Zatsepin, G. T., Kulikov, G.V.,
            Nechin, Yu. A., Strugal'skiy, Z. S., Khristiansen, G. B.

TITLE: Investigation of the Core of Extensive Atmospheric Showers
            (Issledovaniye stvola shirokogo atmosfernogo livnya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,
            Vol 36, Nr 3, pp 669-681 (USSR)

ABSTRACT: The group of research scientists followed a suggestion made
            by D. V. Skobel'tsyn to investigate the passage of extensive
            atmospheric showers through matter simultaneously in different
            depths; in this connection an investigation of the shower
            core was carried out. Figure 1 gives a block scheme of the
            experimental arrangement used, which furnished data concerning
            the electron-photon and the nuclear-active components of the
            shower core. The experimental arrangement consisted essentially
            of a diffusion chamber (0.64 m^3), 124 ionization chambers in
            hodoscope-connection, special filters and 672 Geiger-Mueller
            (Geyger, Myuller) hodoscope counters of different sizes. The
            method, which is described as new, is described in detail,

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and the possibilities it offers are discussed. The entire
device remained in operation for 1300 hours and recorded more
than 10,000 passages of extensive air showers. Within 1,000
hours 28 passages of shower cores with a shower particle
number of $N > 10^5$ through the first row of ionization chambers
were recorded. Figure 4 shows a photograph of the diffusion
chamber for such a passage and the corresponding pulse oscil-
logram of 64 ionization chambers. The article gives numerous
individual data concerning different showers as e.g. the
ionization distribution in the 64 ionization chambers of the
first and second row respectively for $N = 5.10^5$, $1.5.10^5$
and $N = 10^5$ with a spatial distribution of energy flux
$\sim 1/r^3$ (Fig 6). Figure 8 shows the same, expressed by the
number of relativistic particles passing through the ionization
chambers of the first and second row for $N = 10^5$ and
2.10^4 and an energy flux $\sim 1/r^2$ and $\sim 1/r$. Figures 6 and 8
show the particle flux distribution in the diffusion chamber
for $N = 2.10^6$ and $3.5.10^4$ respectively. In extensive air

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showers with $N > 10^5$ it was observed in the shower core
that the total energy of nuclear-active particles
is of the order of the energy of the electron-photon com-
ponent at the same distance from the axis; for individual
showers, however, the ratio of these energies showed different
values. The energy current density of the electron-photon
component shows an increase of up to $r = 20 + 30$ cm from
the shower axis; the course of energy flux density in depen-
dence on r cannot be represented by a general formula. It
fluctuates between $\sim 1/r$ and $\sim 1/r^3$. The energy fluxes of
electron-photon and nuclear-active components of the shower
core show considerable fluctuations (up to 10 times). The
authors finally thank Academician D. V. Skobel'tsyn for his
help and interest. M. N. Sericglehsky for his collaboration,
Professor N. A. Dobrotin for his help and discussions, and
further also a group of collaborators of the MGU: A. ...,
Abrosimov, S. S. Giegolavskiy, B. V. Sabbotin, A. D. Verlykin,
A. B. Kanner, K. R. Somov for their help in carrying out
experiments. There are 8 figures, 2 tables, and 12 references,
11 of which are Soviet.

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ASSOCIATION: Moskovskiy gosudarstvennyy universitet
             (Moscow State University)
             Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR
             (Physics Institute imeni P. N. Lebedev of the Academy of
             Sciences, USSR)

SUBMITTED: July 21, 1958

Khristiansen, G. B.

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SOV/56-36-3-16/71

21(7)
AUTHORS: Abrosimov, A. T., Dmitriyev, V. A., Kulikov, G. V., Massal'skiy, Ya. I., Solov'yev, M. I., Khristiansen, G. B.

TITLE: The Nuclear-Active Component of High Energy in Extensive Atmospheric Showers at Sea Level (Yaderno-aktivnaya komponenta vysokoy energii v shirokikh atmosfernykh livnyakh na urovne morya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 751-761 (USSR)

ABSTRACT: In the present paper the authors report about statistical investigations of nuclear avalanches in extensive air showers at sea level by means of a sensitive detector. Measurements were carried out in 1957 by means of a device for combined investigations of extensive air showers which is now in operation at the MGU. It has 4 cylindrical pulse ionization chambers under a lead-graphite filter and 720 Geiger-Mueller (Geiger-Müller) counters in hodoscope connection for the recording and energy determination of nuclear particles. The counters were connected in coincidence groups (total area 1320 cm²), so that sixfold coincidence pulses were recorded. Figure 1 gives a rough outline of the device including its dimensions.

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The recorded and investigated showers are divided into 4 groups according to the particle number N:

1) $1 \cdot 10^4 < N_1 < 3 \cdot 10^4$; 2) $3 \cdot 10^4 < N_2 < 1 \cdot 10^5$;
3) $1 \cdot 10^5 < N_3 < 5 \cdot 10^5$; 4) $5 \cdot 10^5 < N_4 < 2 \cdot 10^6$.

For these 4 groups table 1 gives the number of particles with energies greater than one given, and also the maximum energy of the nuclear-active particle of individual groups. For the latter the following applies:

group N	E_{nucl}^{max}	r (R = radius of the investigated shower range)
1 N_1	$4.7 \cdot 10^{12}$ ev	1.8 ± 0.5
2 N_2	10^{13} ev	1.0 ± 0.2
3 N_3	$1.8 \cdot 10^{13}$ ev	0.9 ± 0.3
4 N_4	$6 \cdot 10^{13}$ ev	0.7 ± 0.3

Figure 2 shows the course of the spectrum for the two extreme groups. Further investigations deal with the spatial distribution of the energy flux of the nuclear-active component.

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The Nuclear-Active Component of High Energy in Extensive Atmospheric Showers at Sea Level

figure 3 shows the diagram for 4 shower groups with particle energies of $1 \cdot 10^{11} - 3 \cdot 10^{11}$ ev, $3 \cdot 10^{11} - 1 \cdot 10^{12}$, $> 1 \cdot 10^{12}$ and $N > 8 \cdot 10^{11}$ ev. Figure 4 shows the course of energy flux density for N_1, N_2 and N_3, and figure 5 shows the distribution of the energy flux $2 n$ a shower with $N = 2 \cdot 10^5$. It was found that the energy of the nuclear-active component in some showers with equal N may differ considerably. Results are discussed, and in an appendix the energy distribution with respect to primary particles is investigated. The authors finally thank S. I. Vernov, G. T. Zatsepin for their help, valuable remarks, and discussions. They further thank S. I. Nikol'skiy, N. I. Grishkin, and Y. N. Sokolov for taking part in measurements. There are 6 figures, 2 tables, and 17 references, 15 of which are Soviet.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta (Institute for Nuclear Physics of Moscow State University)

SUBMITTED: September 15, 1958

21(8)   SOV/56-36-4-4/70

AUTHORS: Dmitriyev, V. A., Kulikov, G. V., Massal'skiy, Ye. I.,
              Khristiansen, G. B.

TITLE: The Spatial Distribution of the Energy Flux of the Electron-
              Photon Component of Extensive Atmospheric Showers (Prostranst-
              vennoye raspredeleniye potoka energii elektronno-fotonnoy kom-
              ponenty shirokikh atmosfernykh livney)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36,
              Nr 4, pp 992-1000 (USSR)

ABSTRACT: In the present paper the authors report on the results obtained
              by measurements carried out between June 1957 and February 1958
              at sea level by means of a device for the complex investi-
              gation of extensive air showers. The device is at present in
              operation at MGU (Moscow State University). It is described in
              detail and is illustrated by figure 1 in form of a schematical
              drawing. The ionization chambers used had a diameter of 25 cm
              and a length of 1 m, the total area covered by them amounting
              to 3 m^2; they were filled with very pure argon, pressure 3 atm,
              and were enclosed on all sides by filters. The counters, each

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arranged in such a manner that they operated simultaneously within a range of distances of 1 - 50 m from the shower axis. A total of 2000 Geiger-Mueller counters in hodoscope connection (GK-7) was used. Showers with particle numbers of from $1 \cdot 10^4$ to $2 \cdot 10^6$ were investigated. The showers were divided into groups with the average particle numbers $< 1 \cdot 10^4$, $2 \cdot 10^4$, $5.6 \cdot 10^4$, $2 \cdot 10^5$, $5.7 \cdot 10^5$ and $> 10^6$ for the 6 N_i-groups. For energy flux density it holds that $\varrho_E = n(t) \int_0^\infty \beta dt$ and for $t = 8$

$$\varrho_E = \int_0^{t \cdot l} n(t)\beta dt + \int_0^\infty \beta n(t=8)\exp(-\mu_t t)dt$$ (Figure 2 shows the course of these curves for the N_4-group). $n(t)$ denotes the particle number in dependence on the penetration depth t, and β denotes the average energy loss per t-unit. Figure 3 in semilogarithmic scale shows the course of energy flux density for the groups $N_1 - N_5$. Further diagrams show the dependence of electron-photon component energy on the distance from the shower axis r

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The Spatial Distribution of the Energy Flux of the Electron-Photon Component
of Extensive Atmospheric Showers

and on N. Further data concern investigations of the meson
component. For $r < 6$ m it holds that

$$N_\mu = 10^{-2} \int \frac{kN}{r} 2\pi r dr = 7.3 \cdot 10^{-4} N, \ (k = 2 \cdot 10^{-3}) \Delta E_\mu \ (< 6m) \sim$$

$0.005 \ E_{el-ph}$ $(< 6m)$ for the share of the muon component in
energy flux. For the electron-photon component the following
holds for n: $n = -1.5 \pm 0.2$ at $1m < r < 8m$ and
$\qquad\qquad n = -2.0 \pm 0.3$ at $10m < r < 50m$.
The spatial energy distribution function of this component does
not depend on N for showers with the total particle number of

$N = 10^4 - 10^6$. The spatial distribution of the energy fluxes
in the central part of the shower agrees with the cascade
theory calculations in the case of a cascade parameter $s = 1.2$
being used. It was further found that with an increase of
distance from the shower axis the energy flux of the electron-
photon component decreases more slowly than the energy flux
of the nuclear-active component. In a circle with the radius

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The Spatial Distribution of the Energy Flux of the Electron-Photon Component
of Extensive Atmospheric Showers

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21(0)
AUTHORS: Vernov, S. N., Gorchakov, Ye. V.,   SOV/56-36-4-39/70
               Ivanenko, I. P., Khristiansen, G. B.

TITLE: On the Development of the Nuclear- Active Components
               in Extensive Atmospheric Showers (O razvitii yaderno-
               aktivnoy komponenty shirokikh atmosfernykh livney)

ABSTRACT: Already Guzhavin, Guzhavina and Zatsepin (Ref 1) calculated
               the height dependence of high-energy nuclear-active
               particles and the number of high-energy μ-mesons at sea
               level, as well as the height-dependence of the nuclear-
               active and of the soft component of extensive air showers.
               The elementary act was calculated according to Landau
               (Ref 2) and Vernov (Ref 3). For all energies the collision
               cross sections were calculated, and for the free path in
               air the value $\lambda_0 = 65 \div 70$ g/cm^2 was obtained. The results
               of calculations depend in a high degree on λ_0; however,

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On the Development of the Nuclear- Active Components   SOV/56-36-4-39/70
in Extensive Atmospheric Showers

λ_0 is at energies of $\gtrsim 10^{10}$ ev not known from experiments.
Therefore, the authors of this paper calculated different
characteristics for the nuclear-active (n.a.) component of
extensive air showers (e.a.sh.), in which λ_0 is determined
by the type of the elementary act and the experimental range
of the absorption of n.a. particles ($E \sim 10^{12}$ ev). By making
simple assumptions concerning the nature of the elementary
act the spectrum of the n.a. particles in e. a. sh. was
computed, and likewise the ranges for the absorption of n.a.
particles and the energy fluxes in the showers. Also the
probability for the observation of one or two high-energy
n.a. particles in a given altitude is estimated. The main
aim of this paper was to find characteristics of the
e. a. sh. for various parameters of the elementary act
and λ_0 , which are sensitive to the nature of interation.

It was found that besides the e.a.sh. characteristics,
which depend only weakly on the nature of the elementary
particle, there exist also such as are highly dependent.
An exact experimental investigation of the latter may lead
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On the Development of the Nuclear- Active Components in SOV/56-36-4-39/70
Extensive Atmospheric Showers

There are 2 figures and 11 references, 9 of which are
Soviet.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo
                universiteta (Institute of Nuclear Physics of Moscow
                State University)

SUBMITTED: October 16, 1958

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DMITRIYEV, V.A.; KULIKOV, G.V.; KHRISTIANSEN, G.B.

Investigation of high-energy nuclear-active particles at sea
level. Zhur.eksp.i teor.fiz. 37 no.4:893-905 O '59.
(MIRA 13:5)

1. Institut yadernoy fiziki Moskovskogo gosudarstvennogo
universiteta.
            (Cosmic rays)

ABRASIMOV, A.T.; BAZILEVSKAYA, G.A.; SOLOV'YEVA, V.I.; KHRISTIANSEN, G.B.

Extensive air showers involving ultrahigh energies.   Zhur. eksp.
i teor. fiz. 38 no.1:100-107 Jan '60.   (MIRA 14:9)

1. Institut yadernoy fiziki Moskovskogo gosudarstvennogo universi-
tet i Fizicheskiy institut im. P.N.Lebedeva AN SSSR.
                        (Cosmic rays)

VERNOV, S.N.; GORYUNOV, N.N.; DMITRIYEV, V.A.; KULIKOV,G.V.; NECHIN, Yu.A.;
KHRISTIANSEN, G.B.

Function of the spatial distribution of a flux of charged particles
in an individual extensive air shower. Zhur. eksp. i teor. fiz. 38
no.1:297-298 Jan '60.   (MIRA 14:9)

1. Institut yadernoy fiziki Moskovskogo gosudarstvennogo universi-
teta.
(Cosmic rays)

S/056/60/039/002/042/044
B006/B070

AUTHORS: Vernov, S. N., Ivanenko, I. P., Kulikov, G. V.,
             Khristiansen, G. B.

TITLE: The Nature of the Particle Beams in the Core of an Extensive
             Air Shower /9

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960,
             Vol. 39, No. 2(8), pp. 509 - 512

TEXT: In an earlier paper (Ref. 1) the authors communicated their
investigations of a shower core by means of diffusion chamber. They found
that narrow beams consisting of 4-15 particles appear, and the beam
trajectories are collinear. These particle beams are, either, cores of
electron-photon avalanches released from π^0-mesons, or groups of high-
energy muons. Which of these alternatives is correct, is now investigated.
In the present paper, the authors show that the latter is much more
probable. The first assumption is discussed in detail, and the experiment
and its results are analyzed from this stand-point. The observed number
of particles in the beam can only be released by primary particles whose

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The Nature of the Particle Beams in the Core   S/056/60/039/002/042/044
of an Extensive Air Shower   B006/B070

energy $E_0 \geqslant 10^{12}$ ev. The energy spectrum of electrons and photons in the
avalanche at a depth of 2t-units had the following form (N - number of
particles released by particles with $E_0 = 10^{12}$ ev):

E	10^8	10^9	10^{10}	10^{11}
$N_{el}(>E)$	5.5	4.0	2.5	0.5
$N_{phot}(>E)$	10	8.0	4.0	0.8

For their experiments, the authors used a plate of lead glass (type TF-1
(TF-1)) with high lead content. This plate covered one half of the
diffusion chamber. 850 hours of measurement were made in the open chamber
and 440 hours in the closed one. The actual number of particles observed
in the showers is much smaller than that which would be expected if the
first assumption on the nature of the collinear beam were true. Experi-
ments performed with diffusion chamber, arranged above two rows of
ionization chambers, gave similar results. The second assumption, that
the observed beam consists of μ-mesons, is then briefly discussed. For

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of an Extensive Air Shower   B006/B070

$E_{\mu} = 10^{13}$ ev, a value 0.3 per muon is obtained for the probability of
electron-positron pair production in the filter of lead+graphite
(~ 10 t-units over the second row of ionization chambers). The number of
particles in the avalanche cores recorded in the second row of chambers,
(Φ_{ex}) in ΔE, agrees with the number of pair production calculated from
muons (Φ_{th}):

ΔE ev	2.10^9	$2.10^9 - 2.10^{10}$	2.10^{10}
Φ_{ex}	39	7	2
Φ_{th}	40	5	3

Also the absence of multiplication on the passage of the beam through
0.8 t-units of lead glass agrees with the assumption that a high-energy
muon beam is concerned. The authors thank L. G. Smolenskiy and
B. A. Zelenov for help in the experiments and S. F. Semenko for help in
the calculations. There are 1 table and 5 Soviet references.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo univer-
             siteta (Institute of Nuclear Physics of the Moscow State University)
SUBMITTED: June 20, 1960
Card 3/3

KHRISTIANSEN, G. B., VERNOV, S. N., KHRENOV, B. A., KULIKOV, G. V.,

NECHIN, Yu. A., SOLOV'YEVA, V. I.

"Primary Cosmic Ray Component in Super High Energy Region."

report submitted for the Intl. Conf. on Cosmic Rays and the Earth Storm
(IUPAP) Kyoto, Japan 4-15 Sept 1961.

KHRISTIANSEN, G. B., BELYAYEVA, I. F., ABROSIMOV, A. T., ATRASHKEVICH, V. J.,

DMITRIYEV, V. A., NECHIN, YU. A., KHRENOV, B. A., KULIKOV, G. U., SOLOVYEVA, V. I.

"The Structure of Extensive Air Showers at Sea Level."

report submitted for the Intl. Conf. on Cosmic Rays and Earth Storm (IUPAP)
Kyoto, Japan 4-15 Sept. 1961.

KHRISTIANSEN, G. B., VERNOV, S. N., DMITRIYEV, V. A., KHRENOV, B. A.,

Ghalam-Sadik, M., Khva , Ly-Don.

"On Mu-Meson Beams in EAS and the Investigation of Mu-Meson
Spectrum."

report submitted for the Intl. Conf. on Cosmic Rays and Earth Storm (IUPAP)
Kyoto, Japan 4-15 Sept. 1961.

27283   S/056/61/041/002/004/028
B102/B205

3.2410

AUTHORS: Vernov, S. N., Solov'yeva, V. I., Khrenov, B. A.,
Khristiansen, G. B.

TITLE: Fluctuations of the muon flux in extensive atmospheric
showers

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41,
no. 2(8), 1961, 340 - 353

TEXT: The study of fluctuations of the muon flux in extensive atmospheric
showers is very interesting, since the fluctuations accompanying the
formation of avalanches of high-energy nuclear-active particles in the
atmosphere, as well as the applicability of the various models of shower
formation can be estimated from their character. This article gives a
detailed presentation of the results of an investigation of muon-flux
fluctuations in extensive atmospheric showers, which were carried out
with a special device for comprehensive studies of such showers, made
available by Moskovskiy gosudarstvennyy universitet (Moscow State Uni-
versity). First, the authors give a detailed description of the experi-

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S/056/61/041/002/004/028
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Fluctuations of the muon flux...

mental arrangement which used numerous Geiger-Müller counters in hodoscopic arrangement. Fig. 2 shows a muon detector. Detectors of this type, used for measurements on the earth surface, had a total area of $4.75 \ m^2$; at a depth of 20 m water equivalent, it was $3.2 \ m^2$, and at 40 m water equivalent, $6.3 \ m^2$. The arrangement was designed in such a way that sixfold coincidences could be recorded. Showers with $N > 10^5$, in which the numbers of muons with $E > 4 \cdot 10^8$ ev were determined, were examined more closely. In order to eliminate the nuclear-active effect, only the records of those detectors were taken into account, which were more than 50 m away from the shower axis. The arrangement made it possible to measure the total number of shower particles and the number of muons in the shower simultaneously. The showers investigated were grouped as follows:

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Fluctuations of the muon flux...

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A - Detectors on the earth surface

Detectors

$$\begin{cases} N = (2 - 5) \cdot 10^6 \\ N = (5 - 10) \cdot 10^6 , \\ N \geqslant 10^7 \\ N = (2 - 4) \cdot 10^6 \\ N \geqslant 4 \cdot 10^6 \end{cases}$$

Detectors B

$$\begin{cases} N = (1 - 2) \cdot 10^6 \\ N = (2 - 4) \cdot 10^6 . \\ N \geqslant 4 \cdot 10^6 \end{cases}$$

The distribution of events with respect to the ratios q/p (q - number of recorded muons, p - average number of muons to be expected) for the groups (A: $N \geqslant 5 \cdot 10^6$; Б : $N \geqslant 4 \cdot 10^6$; B: $N \geqslant 4 \cdot 10^6$) is given in a table.
Conclusions: The slight fluctuations of the muon flux in showers with a given number of particles, which were observed experimentally, contradict the conception of the development of extensive air showers proposed by T. E. Cranshaw, and A. M. Hillas in a report delivered at the Internatio-nal Conference on Cosmic Particles. The fact that the experimentally

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Fluctuations of the muon flux...

observed fluctuations of the muon flux do not exceed the theoretically predicted fluctuations (theory takes into account only fluctuations at the altitude at which the primary shower-producing particle undergoes its first interaction) corroborates theory. Calculations show that in the case of a shower developing without fluctuation, the form of distribution with respect to the muon number n_{μ} in a shower with a given number of particles is highly sensitive to the quantity $\varepsilon = (\Lambda + B)/\lambda - \gamma' - 1$. Since Λ and γ' are known, the value of λ can be estimated from the form of distribution with respect to n_{μ} (λ is the interaction mean free path of the ultrahigh-energy particles releasing the showers. In order to obtain the exact distribution of muon fluxes, it is necessary to improve the experimental conditions. The authors thank I. P. Ivanenko for a dis- cussion, and K. I. Solov'yev, V. Sokolov, Ye. Shein, V. Putintsev, I. Vasil'chikov, V. Nazarov, G. Degtyareva, N. Proshina, and I. Massal'skaya, co-workers of MGU, for assistance. There are 4 figures, 4 tables, and 8 references: 7 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo univer- siteta (Institute of Nuclear Physics of Moscow State Uni-

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Fluctuations of the muon flux...   17283   S/056/61/041/002/004/028
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versity)
SUBMITTED: March 13, 1961
Legend to the Table: (1), (3), (6): Experimental distributions;
(2), (4), (7): distribution to be expected from the formula

$$\sum_{q=0}^{p_i/3} W(q), \qquad (\text{для } q/p = 0 \div 1/3),$$

(2)

$$\sum_{q=p_i/3}^{2p_i/3} W(q) \quad (\text{для } q/p = 1/3 \div 2/3), \text{ и т. д.}$$

(8): distribution to be expected from the factor given in column 5 and
from the statistical fluctuations. The last line but one gives q/p of all
events.

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S/048/62/026/005/014/022
B102/B104

$3,2410 \ (2205, 2705, 2805)$

AUTHORS: Vernov, S. N., Khristiansen, G. B., Belyayeva, I. F.,
             Dmitriyev, V. A., Kulikov, G. V., Nechin, Yu. A.,
             Solov'yeva, V. I., and Khrenov, B. A.

TITLE: The primary cosmic-ray component at superhigh energies and
             some peculiarities of its interaction with nuclei of air
             atoms

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya,
             v. 26, no. 5, 1962, 651-657

TEXT: The paper is a report on experiments with the Moscow University
large apparatus (area $4 \cdot 10^4 \ m^2$) for comprehensive studies of extensive
air showers induced by high-energy cosmic particles. The charged-particle
detectors (Geiger counters in hodoscope arrangement) cover an area of
110 m^2, the muon detectors (2-3 counter layers shielded with lead and iron,
in hodoscope arrangement) more than 12 m^2, 6.3 m^2 of which are under

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S/048/62/026/005/014/022
B102/B104

The primary cosmic-ray component ...

40 m water equivalent. The nuclear-active-particle detectors form a system of 128 ionization chambers (8 m^2) shielded by lead and graphite filters. The number of muons produced in charged-pion decay was estimated (the pions were assumed to be formed in gamma-quantum photoeffect on nuclei of air atoms): $N_\mu^r(E) \leqslant \sigma_0 E_0/1.8(1-\alpha)E$, $\alpha \leqslant 0.5$, $\sigma_0 < 10^{-3}$; for $E_0 \approx 10^{16}$ ev and $E_\mu = 10^{10}$ ev ($\alpha = 0.5$), $N_\mu^r(10^{10}) \leqslant 10^3$. The number N_μ^n of muons in nuclear showers was measured. For showers with $N = 7 \cdot 10^6$ a mean number of $8 \cdot 10^4$ muons with $E \geqslant 10^{10}$ ev is to be expected. The spatial muon flux distribution was determined for these two types of showers (ρ_μ^n and ρ_μ^r). In the case of a simple model of air shower production (Suppl. Nuovo Cimento, 2, 649, 1958), an analysis of the experimental data yields $N = k_e E_0 \exp(-x + x_m + x_0)/\Lambda$; E_0 is the energy of the primary particle, x_0 is the depth of its first interaction, $x_m = B \log E_0$ (x - depth of observation), N is the total number of

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The primary cosmic-ray component ...

shower particles; the number of muons $N_\mu = k_\mu E_0^\alpha$; $\Lambda = 200$ g/cm^2,

$B = 30$ g/cm^2 and $\alpha = 0.8 \pm 0.1$. If the primary energy spectrum has the

shape $A E_0^{-(\gamma+1)} dE_0$, at fixed N the N_μ distribution has the shape

$N_\mu^{1/\alpha \left(\frac{\Lambda+B}{\Lambda} - \gamma - 1 \right)} dN_\mu$, Λ being the mean free path with respect to inter-

action. Comparison between experiment and theory yields $\Lambda = (85\pm5)$ g/cm^2,

as an upper limit. For charged muons their energies (E_μ) and numbers

(n_π) were measured and calculated for several altitudes H; W is the

probability for a charged pion produced at H decays without interacting

with an air nucleus. The results indicate that in ~ 3% of all cases

nuclear interaction is accompanied by a production of narrow beams of

great numbers of charged pions. There are 8 figures.

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The primary cosmic-ray component ...

Величина	$H = 100$ м	$H = 250$ м	$H = 500$ м	$H = 3 \cdot 10^2$ м	$H = 10^3$ м	$H = 5 \cdot 10^3$ м	$H = 10^4$ м	$H = 1,7 \cdot 10^4$ м
E_π, ov	$1,4 \cdot 10^{10}$	$1,8 \cdot 10^{10}$	$3,3 \cdot 10^{10}$	$9,3 \cdot 10^{10}$	$3,3 \cdot 10^{11}$	$6,3 \cdot 10^{11}$	$1,2 \cdot 10^{12}$	$1,7 \cdot 10^{12}$
$n_\pi = \dfrac{3}{W}$	30	15	20	25	75	100	100	90
$n_{\pi_{\text{теор}}}$	9	8	10	16	25	32	36	40

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3, 2410 (2205, 2705, 2805)

AUTHORS: Belyayeva, I. F., Solov'yeva, V. I., Khrenov, B. A., and Khristiansen, G. B.

TITLE: Extensive air showers induced by high-energy photons

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 5, 1962, 658-660

TEXT: Photon-induced extensive air showers (e.a.sh.) (Nuovo Cimento $\underline{17}$, 625, 1960) must differ from heavy-particle induced e.a.sh. by the number of penetrating particles. The upper limit of the number of muons N_{μ} in a photon-induced e.a.sh. and the spatial muon distribution are estimated for $E_{phot} = 10^{10}$ ev and $N = 10^7$ at sea level. The muons are assumed to be produced in $\pi^{\pm}$ decay only, the $\pi^{\pm}$ being the result of photo-nuclear interaction. Muon pair production is ignored. $N_{\mu}(>E) \leqslant 0.8 \cdot 10^{-3} E_0/E$. The spatial meson distribution at sea level

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Extensive air showers induced by ...

is determined for mesons with $E > 1 \cdot 10^{10}$ ev. The transverse momenta of the $\pi^{\pm}$ produced are assumed to satisfy the law $p_{\perp}^{2} \exp\left[-(p_{\perp}/p_{0})^{2}\right]$ with $p_{0} = 1 \cdot 10^{8}$ ev. The distribution curves were found to be similar for electron-photon and ordinary showers, the densities at axial distances between 10 and 100 m differ by a factor of ~ 100; it is concluded that the muon density in photon-induced e.a.sh. will be $\sim 1\%$ of that in ordinary showers with $N \sim 1 \cdot 10^{7}$ at sea level and distances up to 100 m from the shower axis. An analysis of the relation between the number of recorded showers and that of recorded muons showed that of 126 showers with $4 \cdot 10^{6} \leqslant N \leqslant 2 \cdot 10^{7}$ all those which could have been photon-induced were recorded. This indicates a 75% probability that $\alpha < 0.01$. There are 2 figures.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki
               Moskovskogo gos. universiteta im. M. V. Lomonosova
               (Scientific Research Institute of Nuclear Physics of
               Moscow State University imeni M. V. Lomonosov)

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S/048/62/026/005/016/022
B108/B102

3,24/0

AUTHORS: Vernov, S. N., Dmitriyev, V. A., Khristiansen, G. B., and Gulyam Sadyk Mukhibi

TITLE: Study of the high-energy muon spectrum at a depth of 40 m water equivalent

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 5, 1962, 661-667

TEXT: The underground muon spectrum was studied with an array of ionization chambers (overall area, 1.75 m^2) with 48 Geiger-Müller counters (1.6 m^2) operating at energies from 10^{10} to 10^{13} ev. The muon spectrum was determined from the spectrum of showers induced by high-energy muons in the ionization chambers. The spectrum of the showers recorded, each of which involved $\geqslant 200$ relativistic particles, could be approximated by an exponential law with the index $\gamma = -1.9 \pm 0.2$. In the case of showers with $\geqslant 2000$ particles, $\gamma = -1.8 \pm 0.4$. The strongest showers involved more than 30,000 particles. The data obtained show that the muon-energy

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Study of the high-energy...

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spectrum is uniform throughout the range of 10^{11} to 10^{13} ev. The constant exponent γ in this range is indicative of a more complex nature of muon production in the atmosphere than has hitherto been assumed. The production of muons by K-mesons, which would increase the exponent γ, is also considered. There are 3 figures.

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35562
S/056/62/042/003/018/049
B102/B138

$\partial 4\ 6700$

AUTHORS: Vernov, S. N., Li Don Khva, Khrenov, B. A., Khristiansen, G. B.

TITLE: Muon beams in extensive air showers

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 42, no. 3, 1962, 758 - 769

TEXT: The underground measurements of cosmic-particle distributions des-cribed in Ref. 1 (ZhETF, $\underline{37}$, 1252, 1959) have been continued. The spatial muon distributions have been measured at a depth of 40 m water-equivalent by means of Geiger counters in hodoscope circuit. The total area covered by the counters was 1.2 m^2. The spatial muon distribution was characterized by the distance D between the muon tracks in dependence on M (number of recording counters in the middle row), N (number of particles in the shower) and R (distance from the shower axis on the earth's surface). The showers recorded were divided into two groups: R < 30m (N=5·10^4-10^6), and R > 50m (N = 10^6 - 2·10^7). The meson track distribution determined was analyzed

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Muon beams in ...

by the Monte-Carlo method. Since in the central region of extensive air showers ($r < 30$ m from the shower axis) the muon trajectiories are not independent of each other, it is concluded that there exist pairs and groups of mesons related with each other. A characteristic feature of the central region is narrow muon groups ($d \sim 0.2$m), muon beams, whose number rapidly increases with N. For $N > 10^6$ several narrow muon beams were recorded and the distance between them reached several meters. It is probable that these beams originate in nuclear interactions. For an exact interpretation measurements with large-area arrangements (~ 10 m^2) would be necessary. There are 4 figures, 5 tables, and 7 references: 6 Soviet and 1 non-Soviet.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta (Institute of Nuclear Physics of Moscow State University)

SUBMITTED: September 30, 1961 (initially) December 9, 1961 (after revision)

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S/056/63/044/002/003/065
B102/B166

AUTHORS: Dmitriyev, V. A., Khristiansen, G. B.

TITLE: Investigation of the energy spectrum of high-energy muons at a depth of 40 m water equivalent in the ground

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 44, no. 2, 1963, 405-412

TEXT: In order to obtain information on the origin of high-energy muons, the authors measured the spectrum of extensive bursts induced by high-energy muons in the range from 10^{11} to $3 \cdot 10^{12}$ ev. The showers were generated in 16 cm thick lead filters arranged above two groups of ionization chambers (total area 1.75 m^2). The recording device provided with a pulse-height analyzer of 10% accuracy had a capacity of from 30 to 100,000 relativistic particles. The composition of the bursts is mainly determined by pion energy losses, i.e. by bremsstrahlung and particles arising in electromagnetic muon interactions and, to a lesser extent, also by nuclear interactions. The apparatus was in operation for 1200 hrs; the number of showers plotted against the number of relativistic particles per

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Investigation of the energy ...

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B102/B186

shower shows an exponential drop from n = 100 to n = 100,000 with a power of γ = -1.9 ± 0.2. If the muon energy spectrum can be given by

$\varphi(E_\mu)dE_\mu = AE_\mu^{-(\gamma+1)}dE_\mu$, then it is connected with the burst spectrum

$b(\geqslant n) = Ba\gamma^{-1}(10^8 n)^{-\gamma}$, with $B \simeq 9 \cdot 10^{-4} \gamma^{-2}$. The muon spectrum given by this relation is compared with calculations according to the Monte-Carlo method. Various corrections and the uncertainty induced by the error of γ were considered. The results are in relatively close agreement, and a comparison of the authors' results with those from other publications is also satisfactory, with the exception of the spectrum obtained by A. L. Rodgers (Proc. Phys. Soc. 78, 918, 1961) for E_μ > 100 Bev. For E > 10^{12} ev the results seem to be inconsistent with the present assumptions on muon production in $\pi^\pm$ or K decay. There are 6 figures and 3 tables.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo uni-
               versiteta (Institute of Nuclear Physics of the Moscow
               State University)

SUBMITTED: July 19, 1962
Card 2/2

S/056/63/044/002/027/065
B102/B186

AUTHORS: Vedeneyev, O. V., Dmitriyev, V. A., Khristiansen, G. B.

TITLE: Amplitude distribution of bursts produced by high-energy muons under thick filters

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 44, no. 2, 1963, 556-560

TEXT: The Monte Carlo method is used for calculating the amplitude distribution of monoenergetic muon bursts ($E_\mu = 10^{13}$ and 10^{14} ev) under one or several lead shields of 15 cm diameter. The bursts are assumed to be due only to pair production and bremsstrahlung in the filter. The contribution of nuclear interactions is ignored since it is at least one order of magnitude smaller than that of bremsstrahlung. The δ-electrons produced by muons can also be neglected if the shower contains many ($n > 10$) relativistic particles; the same is the case for electron-positron pairs of less than $6 \cdot 10^8$ ev since the muon energy losses amount to less than 2%. The muon energy is assumed to remain constant throughout the filter; this can be done since the total range of these high-energy muons

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Amplitude distribution of ...

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$(\sim 3 \cdot 10^5$ g/cm^2) is much larger than the thickness of the thickest filter (150 cm lead ~ 1700 g/cm^2). The probabilities for muon interactions per t-unit with losses $\geqslant 6 \cdot 10^8$ ev are 0.045 (10^{13} ev) and 0.090 (10^{14} ev); if only pair production is considered they are 0.044 and 0.089, respectively. The distributions were calculated from the data of 300 events and are shown in Figs. 2 and 3. There are 3 figures.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo
                universiteta (Institute of Nuclear Physics of the Moscow
                State University)

SUBMITTED: July 12, 1962

Fig. 2. Amplitude distribution for $E_\mu = 10^{13}$ ev and 15 cm lead ($= 33$ t-units). Solid line: Pair production plus bremsstrahlung; dashed line: pair production alone.
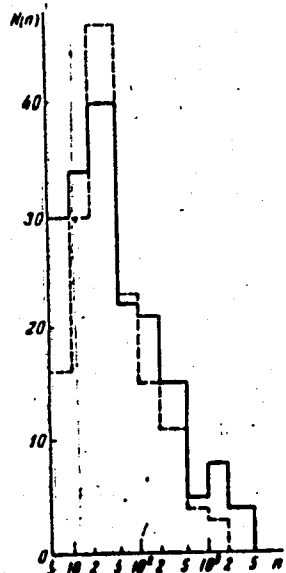
Fig. 3. Amplitude distribution for $E_\mu = 10^{14}$ ev and 33 t-units (solid line) and 66 t-units (dashed line). Both pair production and bremsstrahlung are taken into account.

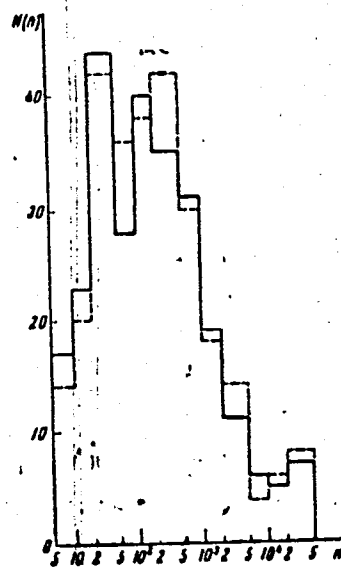Card 2/3

Amplitude distribution of ...

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Fig. 2

Fig. 3

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B108/B186

AUTHORS: Fomin, Yu. A., Khristiansen, G. B.

TITLE: Size distribution of extensive atmospheric showers

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 44,
               no. 2, 1963, 666-675

TEXT: The rapid change in the power exponent of the spectrum with respect
to the number of particles of extensive showers, observed recently for
$N \sim 10^5 - 10^6$ at sea level (G.B. Kulikov, G.B. Khristiansen. Nuovo Cim.,
Suppl., 8, 1958; S. Fukui et al. Progr. Theor. Phys., Suppl., 16, 1, 1960;
H.R. Allan et al. Preprint, 1962) is explained here. For this purpose
it is sufficient to assume that the distribution of magnetic clouds in
the Galaxy with respect to the parameter lH is such that the diffusion
coefficient for ultrahigh energy cosmic rays changes from D = const to
$D \sim E^\alpha$. E is the energy, l the size of the magnetic cloud, H the magnetic
field strength in it. $\alpha > 0.5$ when the energy changes by one order of
magnitude. The most probable explanation is the one which attributes the
rapid change in the power exponent of the shower spectrum to corresponding

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Size distribution of extensive ...   S/056/63/044/002/041/065
                                        B108/B186

changes in the exponent of the primary energy spectrum. An analysis of
experimental data shows that the primary radiation does not consist of
heavy nuclei only. There are 4 figures and 5 tables.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo
              universiteta (Institute of Nuclear Physics of Moscow State
              University)

SUBMITTED: August 13, 1962

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S. N.;   KHRISTIANSEN, G. B.;   ABROSIMOV, A. M.;   KHRENOV, DMITRIYEV, V. A.
SOLOVYEVA, V. I.;   SOLOVYEV, K.I.:   BELYAYEVA,M.F.;   NECHIN, Yu. A.;   VEDENEYEV,O.N.;
KULIKOV, G. V.;   FOMIN, Yu. A.

Summary of the new data on EAS structure obtained with the aid of the complex
equipment of Moscow State University.

Report submitted foe the 8th Intl. Conf. on Cosmic Rays (IUPAP) Jaipur, India,
2-14 Dec 1963

KHRISTIANSEN, G. B.;   ABROSIMOV, A. M.;   KHRENOV, B. A.;   ATRASHKEVICH, V. B.;
KULIKOV, G. V.;   SOLOVIYEVA, V.I.;   FOMIN, Yu. A.

The cosmic ray primary radiation of ultra high energy.

Report submitted for the 8th Intl. Conf. on Cosmic Rays (IUPAP), Jaipur, India,
2-14 Dec 1963

SYROVATSKIY, S.I.; FOMIN, Yu.A.; KHRISTIANSEN, G.B.

Energy spectrum of primary cosmic radiation and its composition in the region of ultrahigh energies. Zhur. eksp. i teor. fiz. 45 no.5:1595-1602 N '63.
(MIRA 17:1)

1. Fizicheskiy institut imeni Lebedeva AN SSSR i Institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta.

ACCESSION NR: AP4042579   S/0056/64/046/006/2141/2150

AUTHORS: Fomin, Yu. A.; Khristiansen, G. B.

TITLE: Energy spectrum and composition of cosmic rays of galactic
and metagalactic origin

SOURCE: Zh. eksper. i teor. fiz., v. 46, no. 6, 1964, 2141-2150

TOPIC TAGS: cosmic ray, cosmic ray composition, cosmic radiation
energy, cosmic ray origin, galactic cosmic ray, metagalactics

ABSTRACT: To ascertain the contribution of primary cosmic radiation
from galactic and metagalactic sources, the authors calculate the
energy spectrum and composition of cosmic rays of both galactic and
metagalactic origin, starting from the diffusion model of cosmic-ray
propagation, and using more general assumptions concerning the energy
variation of the diffusion coefficient than made heretofore. In ad-
dition, a more detailed comparison is made of the results of the cal-

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ACCESSION NR: AP4042579

culation with the experimental particle-number spectrum of extensive air showers and with the muon number distribution in a shower having a specified number of particles. The comparison results imply that the metagalactic cosmic rays play a major role in the energy region $E > 10^{17}$ eV. The agreement between the theoretical and experimental distributions is good, and the smaller slope of the energy spectrum of the metagalactic cosmic rays does not contradict the existing experimental data in the region $E < 10^{17}$--10^{18} eV. "In conclusion the authors express sincere gratitude to S. I. Sy*rovatskiy for a discussion of the problem and to L. G. Dedenko for communicating the results of his calculations." Orig. art. has: 7 figures, 3 formulas, and 4 tables.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta (Nuclear Physics Institute, Moscow State University)

SUBMITTED: 19Dec63   DATE ACQ: ENCL: 00

SUB CODE: AA, NP   NR REF SOV: 008   OTHER: 004

Card 2/2

L 14804-65   EWG(j)/EWT(m)/FCC/T   IJP(c)/AEDC(a)/AFWL/SSD(a)/ASD(a)-5/
SSD/AS(mp)-2/AFMDC/AFETR/RAEM(c)/ESD(gs)/ESD(t)/Pb-4

ACCESSION NR: AP4049589   S/0048/64/028/011/1876/1885

AUTHOR: Zatsepin, G. T.; Nikol'skiy, S. I.; Khristiansen, G. B.

TITLE: Large atmospheric showers of cosmic radiation

SOURCE: AN SSSR. Izv. Seriya fizicheskaya, v. 28, no. 11, 1964, 1876-1885

TOPIC TAGS: electron, proton, atmospheric shower, Coulomb electron
dispersion, photon, critical energy, primary radiation, energetic
spectrum, magnetic field, diffusion coefficient, metagalactic ray,
muon

ABSTRACT: Electrons constitute the most numerous part of charged
particles in the atmospheric showers, and the loss of electrons in the
ionization process causes the expenditure of much energy by absorption
of shower particles during passage through the atmosphere. The results
of measurements prove that Coulomb electron dispersion in atmospheric
showers is the fundamental process which determines the spatial
distribution of electrons and photons with energies near the
critical energy in the radiation flux. The total energy ϵ of electrons
and photons at the mean density of showers is $\epsilon = 1.9 \times 10^8$ Mev at sea

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ACCESSION NR: AP4049589

level and $\varepsilon \approx 2.1 \times 10^8$ Mev on mountains. Spectra of high-energy
primary radiation were investigated by means of a special installation.
Changes in the energy spectrum and the composition of primary cosmic
rays occur simultaneously in the magnetic field, the strength of which
determines the value of the diffusion coefficient. The energy spectrum
and the composition of metagalactic rays differ from those of galactic
origin. Metagalactic rays are rich in protons and light nuclei of the
same energy as those of the galactic origin. The density of the
μ-meson flux in usual showers is found to be tens and hundreds of times
greater than that obtained from theoretical computations. Orig. art.
has: 5 figures, 10 formulas, and 3 tables.

ASSOCIATION: none

SUBMITTED: 00   ENCL: 00   SUB CODE: AA, ES

NO REF SOV: 019   OTHER: 008   ATD PRESS: 3140

Card 2/2

L 40709-65   EWG(j)/EWT(m)/FCC/T   IJP(c)

ACCESSION NR: AP5012318   UR/0048/64/028/011/1886/1893

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Belyayeva, I. F.;
Dmitriyev, V. A.; Kulikov, G. V.; Nechin, Yu. A.; Solov'yeva, V. I.; Khrenov, B.A.

TITLE: New data on the study of broad atmospheric showers using a complex
apparatus / Report of All-Union Meeting on Cosmic Rays Physics, held in Moscow
from October 4 to 10, 1963/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 28, no. 11, 1964, 1886-1893

TOPIC TAGS: cosmic ray shower, nuclear particle, nuclear physics apparatus

ABSTRACT: Experiments are described that were conducted at Moscow State University
on a complex apparatus for the study of broad atmospheric showers and the mu-
meson component of cosmic rays. The apparatus gave simultaneous information on the
electron-photon, mu-meson, and nuclear-active components of broad atmospheric
showers in each individually-recorded shower. Orig. art. has: 9 graphs, 3 tables.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta im. M. V. Lomonosova (Scientific Research Institute
of Nuclear Physics, Moscow State University)

SUBMITTED: 00   ENCL: 00   SUB CODE: AA, NP
NO REF SOV: 003   OTHER: 006   JPRS

Card 1/1

L 23402-65   EWT(1)/EWG(v)/FCC/EEC-4/EEC(t)/EWA(h)   Po-4/Pe-5/Pq-4/Pae-2/Peb/Pi-4
ACCESSION NR: AP5002095 GW/WS   S/0048/64/028/012/1934/1941

AUTHOR: Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich, V. B.;
Kulikov, G. V.; Solov'yeva, V. I.; Fomin, Yu. A.; Khrenov, B. A.

TITLE: Primary cosmic radiation of superhigh energy

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 28, no. 12, 1964,
1934-1941

TOPIC TAGS: atmospheric shower, shower spectrum, primary energy
spectrum, cosmic ray, atomic number, μ meson, cosmic ray diffusion,
magnetic field, magnetic rigidity, proton, nucleus, diffusion coeffi-
cient

ABSTRACT: The spectrum investigation of large atmospheric showers may
be made by means of the number of particles which is possible to study
using a complex large-scale facility. The spectrum of large atmospheric
showers near sea level changes its form sharply with the change in
the total number N of particles. The transition of cosmic radiation
from the shower spectrum to the primary energy spectrum is performed
using a model of the development of atmospheric showers. The develop-

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23402-65
ACCESSION NR: AP5002095

ment depends upon the number of particles and their atomic number A. These parameters were obtained by analyzing the fluctuations of μ-meson flux measured in the complex facility. The distribution of the meson number depends upon the form of the primary energy spectrum, which is characterized by the exponent γ. Acceleration and diffusion of cosmic rays occur when both a change in the energy spectrum and a change in the composition of rays take place simultaneously. The diffusion of cosmic rays takes place in a magnetic field where the diffusion coefficient is specified by magnetic rigidity, which is equal to $2\epsilon/300H$ for nuclei and $\epsilon/300H$ for protons (ϵ is the energy of a nucleon). A table in the original article contains the percentage of galactic cosmic radiation of various energies. This table shows that the increase of energy causes an increase of heavy nuclei in cosmic radiation of the Galaxy. A decrease in the percentage of light nuclei α and L with the increase in energy is caused by the higher diffusion coefficient. The number of μ-mesons computed theoretically agreed with experimental data up to 10^{15} ev of the primary particles. At energies greater than 10^{17} ev, the experimental data showed more protons and light nuclei than the theor- purports. Orig. art. has: 4 figures, 2 tables, and 12 formulas.   [EG]

Card 2/3

L 23402-65
ACCESSION NR: AP5002095

ASSOCIATION: none

SUBMITTED: 00   ENCL: 00   SUB CODE: AA

NO REF SOV: 008   OTHER: 001   ATD PRESS: 3174

Card 3/3

L 21189-65   EWD(1)/EWT(m)/FCC/T   IJP(c)   S/0048/64/028/012/2087/2092
ACCESSION NR: AP5002109

AUTHOR: Vernov,S.N.; Khristiansen,G.B.; Abrosimov,A.T.; Atrashkevich,V.B.; Belya-
yeva,I.F.; Vedeneyev,O.V.; Dmitriyev,V.A.

TITLE: Description of the modernized complex installation for study of extensive
air showers /Report, All-Union Conference on the Physics of Cosmic Rays held in
Moscow 4-10 Oct 1963/

SOURCE: AN SSSR. Izvestiya, Seriya fizicheskaya, v.28, no.12, 1964, 2087-2092

TOPIC TAGS: cosmic ray measurement

ABSTRACT: During the past two years the installation for comprehensiv investiga-
tion of extensive air showers and high-energy muons has been greatly improved. The
installation is located at Moscow State University and covers an area of about 4
hectares (about 10 acres); it consists of a large number of stationary and mobile
"laboratories". The general layout is shown in the Figure (see Enclosure). In the
mobile "laboratories" (Nos.7 through 16 in the figure) and in the stationary "la-
boratories" (1,2 & 3) in the main building the old system of hodoscopic counters
has been supplemented by an array of 20 scintillation counters with an area of

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L 21189-65
ACCESSION NR: AP5002109   0

0.5 m^2 each, which make it possible to determine the strength of a shower and the orientation of its axis in space. In the underground laboratory the area of the muon detector has been increased from 6 to 45 m^2 and there has been installed a new system of 240 ionization chambers shielded by an absorber, intended for statistical measurements of the energy of muon fluxes. The paper gives diagrams of some of the counter and chamber arrays and describes some of the specific design features of the detectors and associated electronic equipment. A few typical curves are reproduced. The underground installation is characterized by an exceptionally large area, good continuity and a high resolution. Orig.art.has: 1 table and 9 figures.

ASSOCIATION: none

SUBMITTED: 00   ENCL: 01

SUB CODE: AA   NR REF SOV: 002   OTHER: 002

2/3

FOMIN, Yu.A; KHRISTIANSEN, G.B.

Energy spectrum and composition of cosmic rays of galactic
and metagalactic orgin. Zhur.eksp.i teor.fiz. 46 no.6:2141-
2150 Je '64. (MIRA 17:10)

1. Institut yadernoy fiziki Moskovskogo gosudarstvennogo
universiteta.

L 47033-65   EWG(j)/EWT(m)/FCC/T/EWP(j)/EWA(h)/EWA(1)   Pc-4/Peb   IJP(c)   RM

ACCESSION NR: AP5007027   S/0120/65/000/001/0069/0076

AUTHOR: Khristiansen, G. B.; Abrosimov, A. T.; Bogoslovskiy, G. V.;
Boytsov, V. I.; Solov'yev, K. I.

TITLE: Outfit for investigating extensive showers by means of a set of
scintillation counters

SOURCE: Pribory i tekhnika eksperimenta, no. 1, 1965, 69-76

TOPIC TAGS: extensive shower, scintillation counter

ABSTRACT: The addition of 20 scintillation counters in 1962 to the Moscow
University outfit for extensive-shower recording is reported. Plastic (poly-
styrene with 1% PPP + 0.04% POPOP) rectangular $707 \times 707 \times 65$-mm scintillation
counters have a total area of 10 m^2. The counters and the electronic equipment
permit a wide-range recording of stream densities and the relative arrival times
of cosmic particles. Curves of the differential spectrum of pulse heights, of

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L 47083-65

ACCESSION NR: AP5007027

height-channel calibration, and of counter nonuniformity depending on the particle travel are presented. The principal circuits of preamplifiers, amplifiers, pulse-delay measuring devices, and pulse recorders are supplied. "In conclusion, the authors wish to thank S. N. Vernov for directing the work, and V. B. Atrashkevich, Ya. L. Blokh, V. Kh. Leonov, and D. I. Protasov for their help." Orig. art. has: 8 figures and 1 table.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M. V. Lomonosova (Moscow State University)

SUBMITTED: 03Dec63   ENCL: 00   SUB CODE: NP

NO REF SOV: 007   OTHER: 000

Card 2/2

L 1887-66   EWT(1)/EWT(m)/FCC/T/EWA(h)   IJP(c)   GS/GW
ACCESSION NR: AT5022828   UR/0000/65/000/000/0103/0110

AUTHOR: Vernov, S. N.; Solov'yeva, V. I.; Khrenov, B. A.; Khristiansen, G. B.

TITLE: Primary cosmic radiation in the ultrahigh energy range and extensive
air showers

SOURCE: Vsesoyuznoye soveshchaniye po kosmofizicheskomu napravleniyu issledo-
vaniy kosmicheskikh luchey. 1st, Yakutsk, 1962. Kosmicheskiye luchi i problemy
kosmofiziki (Cosmic rays and problems in cosmophysics); trudy soveschaniya.
Novosibirsk, Redizdat Sib. otd. AN SSSR, 1965, 103-110

TOPIC TAGS: extensive air shower, mu meson, primary cosmic ray, cosmic radiation
energy, astrophysic instrument

ABSTRACT: The device used at the MGU for studying extensive air showers (EAS)
has yielded extensive experimental data pertaining to ultrahigh-energy primary
cosmic radiation. The present report cites cumulative experimental data for
1960-1961. The device consists of 18 points (arranged in a circle of 120 m
radius) at which detectors of charged particle densities and mu-mesons are
located (Fig. 1 of the Enclosure). A very valuable feature of the device is its
ability to record high-energy mu-meson fluxes in an individual shower. The
energy spectrum of primary cosmic radiation obtained is discussed. The

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L 1887-66
ACCESSION NR: AT5022828

experimental data are used to determine the probability that pure electron-photon showers comprise a fraction α of the total number of recorded showers n :

$$P(\alpha n) \sim \sum_{n_i} \sum_{m=0}^{n_i} \frac{[\exp(-\alpha n_i)](\alpha n_i)^m}{m!} \left(1 - e^{\rho_{\mu i}^\gamma}\right)^m ,$$

where n_i is the number of EAS with a density of mu-mesons $P_{\mu i}^n$; $P_{\mu i}^\gamma$ is the density of mu-mesons in pure electron-photon showers with the same number of particles N as in the observed EAS. Calculation shows that $\alpha < 2 \times 10^{-3}$ with 90% probability. The upper limit for the fraction of primary γ quanta with energy of $\sim 10^{16}$ ev is from 4×10^{-4} to 10^{-4}. In conclusion, the isotropy of primary cosmic radiation of the highest energy that can be recorded by the device is discussed. Orig. art. has: 2 figures and 2 table.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki MGU (Scientific Research Institute of Nuclear Physics, MGU)

SUBMITTED: 29Oct64   ENCL: 01   SUB CODE: AA

NO REF SOV: 006   OTHER: 006
Card 2/3

L 1887-66

ACCESSION NR: AT5022828   ENCLOSURE: 01

Figure 1. Diagram of cosmic ray and air shower recording device.

a - detectors of charged particle density; b - mu-meson detectors
$$(E \geqslant 6 \times 10^8)$$

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L 4528-66   EWT(m)/FCC/T   IJP(c)

ACC NR: AP5024632

SOURCE CODE: UR/0048/65/029/009/1676/1681

AUTHOR: Vernov, S.N.; Khristiansen, G.B.; Abrosimov, A.T.; Atrashkevich, V.B.; Belyayeva, I.F.; Vedeneyev, O.V.; Kulikov, G.V.; Fomin, Yu. A.; Nechin, Yu. A.; Solov'yeva, V.I.; Khrenov, B.A.

ORG: none

TITLE: Investigations of fluctuations in the development of extensive air showers with a fixed total number of charged particles and a fixed total number of muons /Report, All-Union Conference on Cosmic Ray Physics held at Apatity 24-31 August 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 9, 1965, 1676-1681

TOPIC TAGS: cosmic ray shower, muon, charged particle, extensive air shower, particle distributic particle distribution

ABSTRACT: The authors have employed the modernized installation at Moscow State University, described elsewhere (S.N.Vernov et al., Izv. AN SSSR Ser. fiz., 28, 2087, 1964), to investigate the simultaneous distribution of total number N of charged particles, total number M of muons, and age parameter S in extensive air showers. Showers were selected for which the zenith angle of the axis was less than 30⁰. M was determined from the number of muons recorded by the muon detector and the perpendicular distance of the muon detector from the shower axis with the aid of the known lateral distribution of muons. The relative error in determining M did not exceed 35 %. The

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L 4528-66

ACC NR: AP5024632

error in determining S was estimated to be 0.02 by processing "artificial" showers of known age, calculated by Monte Carlo methods. The data presented were derived from some 300 showers with total numbers of charged particles ranging from 10^5 to 4×10^6. Histograms are given showing the distribution of showers with respect to N with fixed M, with respect to M with fixed N, with respect to S with fixed N, and with respect to S with fixed M, and scatter plots are given for N versus S with fixed M and for M versus S with fixed N. The correlation coefficient of S with M for fixed N ranged between 0.62 and 0.72; the correlation coefficient of S with N for fixed M was $- 0.67$. Orig. art. has: 10 formulas, 4 figures, and 1 table.

SUB CODE: NP/ SUBM DATE: 00/   ORIG REF: 005/ OTH REF: 001

Card   2/2

L 4529-66   EWT(m)/FCC/T   IJP(c)

ACC NR: AP5024633   SOURCE CODE: UR/0048/65/029/009/1682/1685

AUTHOR: Vernov, S.N.; Khrenov, B.A.; Khristiansen, G.B.

ORG: Scientific Research Institute of Nuclear Physics, Moscow State University im. M.V.Lomonosov (Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta)

TITLE: Structure of the central region of a muon shower at 40 m.w.e. /Report, All-Union Conference on Cosmic Ray Physics held at Apatity 24-31 August 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 9, 1965, 1682-1685

TOPIC TAGS: cosmic ray shower, extensive air shower, muon

ABSTRACT: The authors have employed the complex modernized installation at Moscow State University, described elsewhere (S.N.Vernov et al., Izv. AN SSSR. Ser. fiz., 28, 2087, 1964), to investigate the structure of the central regions of muon showers accompanying extensive air showers. The muon flux at 40 m.w.e. underground was found to be proportional to r^n, where r is the distance from the shower axis and n = 1/2 for 7 m $<$ r $<$ 15 m and r = 1 for 15 m $<$ r $<$ 100 m; it was not possible to obtain the lateral distribution for r $<$ 7 m because of the errors in determining r. The ratio of the numbers of counters triggered in the two halves of the muon detector and the probability for triggering neighboring counters were subjected to statistical analysis,

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L 4529-66

ACC NR: AP5024633

and after correction was made for Poisson fluctuations there remained evidence that there exist in the center of the muon shower groups of associated muons with diameters from 2 to 3 m which are capable either of contracting into narrow groups with diamet- ers less than 30 cm or of producing secondary showers. Orig. art. has: 1 formula, 3 figures, and 1 table.

SUB CODE: NP/ SUBM DATE: 00/   ORIG REF: 005/ OTH REF: 000

Card   2/2

L 4480-66   EWT(1)/EWT(m)/FCC/T/EWA(h)   IJP(c)   GW

SOURCE CODE: UR/0048/65/029/009/1696/1701

ACC NR: AP5024637

AUTHOR: Atrashkevich, V.B.; Fomin, Yu. A.; Khristiansen, G.B.

ORG: none

TITLE: Monte Carlo calculations on the fluctuations in the development of extensive air showers /Report, All-Union Conference on Cosmic Ray Physics held at Apatity 24-31 August 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 9, 1965, 1696-1701

TOPIC TAGS: primary cosmic ray, secondary cosmic ray, extensive air shower, nucleon interaction, inelastic interaction, pion

ABSTRACT: The authors have employed Monte Carlo methods to calculate the fluctuations in extensive air showers, initiated by protons with fixed energy, of the total number of electrons, the total number of high energy muons, the age parameter, and the total energy flux in the electron-photon and nuclear-active components. Four different models were employed to describe the elementary high energy nucleon interaction; these models were selected to give an average inelasticity of 0.5 and differed in regard to the frequency and nature of very high energy secondaries. Very high energy pions were assumed to have an interaction free path in air of 80 g/cm^2, to interact with an inelasticity of unity and a multiplicity proportional to the fourth root of the energy, and to produce secondaries of which all have the same energy. Monte Carlo methods were

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L 4480-66

ACC NR: AP5024637

employed to determine the inelasticities and locations of all the interactions of the primary proton and the locations of the interactions of the high energy secondary pions; the further development of the shower was calculated with conventional cascade equations in which the effect of pion decay was included but which are not further specified. Calculations were performed for showers initiated by 10^{15}, 10^{16}, and 10^{17} eV protons. The average values and dispersions of the number of electrons, the number of high energy muons, the age parameter, and the energy flux, and the correlation co-efficient of the age parameter with the number of electrons are tabulated and some of the distributions are presented graphically. These averages, dispersions, and corre-lation coefficients did not vary greatly with the model selected to represent the ele-mentary nucleon interaction event. Formulas are given for calculating the correspond-ing quantities for showers initiated by nuclei on the assumption that the shower ini-tiated by a nucleus of mass number A and energy E is the sum of A showers, each initi-ated by a nucleon of energy A/E. The transformations required for comparing the pre-sent calculations with the experimental results of S.N.Vernov et al. (Izv. AN SSSR Ser fiz., 29, 1676, 1965 /see Abstract AP5024632/) are discussed but the comparison is not made. Orig. art. has: 5 formulas, 2 figures, and 3 tables.

SUB CODE: NP, SUBM DATE: 00/   ORIG REF: 006/   OTH REF: 000

Card 2/2

KHRISTIANSEN, G.B.

Energy spectrum and properties of ultrahigh-energy primary cosmic radiation. Izv. AN SSSR.Ser.fiz. 29 no.10:1872-1875 O '65.

(MIRA 18:10)

1. Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo gosudarstvennogo universiteta im. M.V.Lomonosova.

VERNOV, S.N.; KHRISTIANSEN, G.B.; ABROSIMOV, A.T.; ATRASHKEVICH, V.B.;
BELYAYEVA, I.F.; KULIKOV, G.V.; SOLOV'YEVA, V.I.; FOMIN, Yu.A.;
KHRENOV, B.A.

Ultrahigh-energy primary cosmic radiation according to data on
extensive air showers. Izv. AN SSSR.Ser.fiz. 29 no.10:1876-1880
O '65.   (MIRA 18:10)

1. Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta im. M.V.Lomonosova.

L 25772-66 - EWT(m)/FCC/T   IJP(c)

ACC NR: AP6016380   SOURCE CODE: UR/0048/65/029/010/1876/1880

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich, V. B.;
Belyayeva, I. F.; Kulikov, G. V.; Solov'yeva, V. I.; Fomin, Yu. A.; Khrenov, B. A.

ORG: Scientific Research Institute of Nuclear Physics, Moscow State University im.
M. V. Lomonosov (Nauchno-issledovatel'skiy institut yadernoy fiziki Moskovskogo
gosudarstvennogo universiteta)

TITLE: Primary superhigh-energy cosmic radiation according to data on extensive
atmospheric showers

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 10, 1965, 1876-1880

TOPIC TAGS: cosmic radiation, muon

ABSTRACT: Of interest in the investigation of the primary energy
spectrum of cosmic rays and their composition is the knowledge of
the spectrum of extensive atmospheric showers (e.a.s.) with respect
to the total number N_μ of high energy muons ($E_\mu \geq 10^{10}$ eV) and
the distribution of e.a.s. over the total number of the particles
N_e for a given N_μ. In this connection the authors analyze the
primary energy spectrum of cosmic rays on the basis of experimental
data obtained with a special device for investigating e.a.s. recor-
ded with a probability of $W \geq 0.95$. This device makes it possible
to determine the total number of charged particles in an e.a.s.

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L 25772-66

ACC NR: AP6016380

at the observation level. An averaged function $\rho_\mu(R)$ is plotted to determine the spatial distribution N_μ of the muons, and, thus, the total number of these muons is determined. The distribution of N_e for a given N_μ is evaluated on the basis of data on an e.a.s. with $N_\mu = (1-2) \cdot 10^4$. The experimental findings are found to be in satisfactory agreement with theory. Thus, on the basis of the complex whole of the experimental findings, it may be concluded that the composition of primary cosmic rays in the superhigh-energy region apparently does not significantly differ from the composition in the low-energy region, and the γ-index of the primary energy spectrum is variable rather than constant. Orig. art. has: 5 figures. [JPRS]

SUB CODE: 20, 04 / SUBM DATE: none / ORIG REF: 009 / OTH REF: 002

Card 2/2   CC

L 39838-66   EWT(m)/ECC/T   IJP(c)   GD-2

ACC NR: AP6018853   SOURCE CODE: UR/0367/65/002/006/1075/1086

AUTHOR: Vernov, S. N.; Belyayeva, I. F.; Vedeneyev, O. V.; Dmitriyev, V. A.;
Nochin, Yu. A.; Khristiansen, G. B.

ORG: Institute of Nuclear Physics, Moscow State University (Institut yadernoy fiziki
Moskovskogo gosudarstvennogo universiteta)

TITLE: Fluctuations of the energy fluxes of the nuclear-active and electron-photon
components in extensive air showers /This paper was given at the 14th Annual Conference
on Nuclear Spectroscopy, Tbilisi, February 1964/

SOURCE: Yadernaya fizika, v. 2, no. 6, 1965, 1075-1086

TOPIC TAGS: extensive air shower, electron, photon

ABSTRACT: Experimental data are given on the fluctuations of the energy flux of the
nuclear-active and electron-photon components in extensive air showers and on the
connections of these fluctuations with each other and with fluctuations of the age
parameter s. It is shown that the bulk of these data disagrees with the model described
by Nymmik and Shestoperov (Materials on the All-Union Conference, Apatites, 1964).
The large role of the parameter s and other characteristics for the correct setting-up
of experiments concerning extensive air-showers are discussed. Orig. art. has: 10
figures and 3 tables. /Based on authors' Eng. abst./ /JPRS/

SUB CODE: 03 / SUBM DATE: 23Apr65 / ORIG REF: 014 / OTH REF: 003

Card 1/1   JLS

ACC NR: AP7007081   SOURCE CODE: UR/0048/66/030/010/1685/1689

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich,
V. B.; Belyayeva, I. F.; Vedeneyev, O. V.; Kulikov, G. B.; Nechin, Yu. A.;
Solov'yeva, V. I.; Fomin, Yu. A.; Khrenov, B. A.

ORG: none

TITLE: Phenomenological characteristics of broad atmospheric showers with
a fixed number of μ-mesons and electrons /Paper presented at the All-Union
Conference on Cosmic Radiation Physics, Moscow, 15-20 Nov 1965/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 30, no. 10, 1966,
1685-1689

TOPIC TAGS: mu meson, cosmic radiation

SUB CODE: 20

ABSTRACT: In an earlier work by Vernov et al (Izvestiya Akademii Nauk SSSR,
Seriya Fizicheskaya, 29, 1676, 1965), results obtained in a study at an instal-
lation of Moscow State University on broad atmospheric showers with zenith
angles of 0-30° were reported. These results included the distribution of showers
with a fixed number of electrons N_e with respect to the number of high-energy
mesons N_μ and the age parameter S, distribution of showers with a fixed N_μ with
respect to N_e and S, and the coefficients of the correlation between S and the
fluxes of electrons and μ-mesons. In the work reported in this instance, the
same relations were determined for broad atmospheric showers with zenith angles
of 30-45°. The fluctuations of N_μ, S, and N_e, observed for an effective atmo-
spheric depth of 1240 g/cm^2, were the same as those for vertical showers esta-
blished in the earlier work. To determine the differences due to an increase in
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ACC NR: AP7007081

the effective atmospheric depth of 200 g/cm^2, calculations must be carried out with greater statistical precision. When results of the theoretical calculations on characteristics of broad atmospheric showers at 1240 g/cm become available, the experimental data reported will be useful for the determination of the composition of primary cosmic radiation in the superhigh-energy range. [JPRS: 39,658]

Orig. art. has: 5 figures, 2 formulas and 1 table.

Card 2/2

ACC NR: AP7007082   SOURCE CODE: UR/0048/66/030/010/1694/1696

AUTHOR: Vernov, S. N.; Khristiansen, G. B.; Nechin, Yu. A.; Stoyanova, D. A.;
Khrenov, B. A.

ORG: none

TITLE: Groups of particles at a depth of 40 meters entering into the
composition of broad atmospheric showers /Paper presented at the All-Union
Conference on Cosmic Radiation Physics, Moscow, 15-20 Nov 1965/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 30, no. 10, 1966,
1694-1696

TOPIC TAGS: muon, physics conference

SUB CODE: 20,04

ABSTRACT: A study of the flux of particles at a depth of 40 m underground was
made using the Moscow State University installation for the investigation of
broad atmospheric showers. The purpose of the work described was determination
of the shower-forming capacity of particles belonging to non-Poisson groups
observed in the vicinity of the axis of showers. By assuming that the particles
present in the groups observed were muons and using the experimental data ob-
tained, the authors estimated that the average energy of muons in these shower-
forming groups was $10^{12} < E_\mu < 10^{13}$ ev. The determination of the shower-
forming capacity is of value in estimating the full amount of energy carried
away by a muon group in a broad atmospheric shower. It was shown that the muons
in a group have an energy of $\sim 10^3$ Bev $< E_\mu < 10^4$ Bev. This indi-
cates that a muon group cannot carry away more than 10% of the energy of a
primary particle, and therefore cannot be responsible for the escape of a signi-

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ACC NR: AP7007082

ficant amount of energy in the atmosphere. Presence of concentrated groups of high-energy muons ($E \geq 10^{12}$ ev) at a depth of 40m cannot be explained from the standpoint of theoretical concepts concerning the development of broad atmospheric showers that have hitherto been advanced. Orig. art. has: 4 figures.
/JPRS: 39,658/

Card 2/2.

KHRISTICH, A. O.

Surgical Instruments and Apparatus

Corrugated vascular clamps. Khirurgiia No. 6, 1952.

Monthly List of Russian Accessions, Library of Congress, October 1952. Unclassified.

KHRISTICH, A.D., kandidat meditsinskikh nauk.

Innervation of the cicatrice and of the transplant of the blood vessel wall. Khirurgiia no.9:33-40 S '53.   (MLRA 6:11)

1. Iz kafedry gistologii i embriologii (zaveduyushchiy - professor N.I.Zasybin) i kliniki fakul'tetskey khirurgii (zaveduyushchiy - professor T.Ye.Gai-lorybov).   (Blood vessels--Transplantation)

KHRISTICH, A.D., kandidat meditsinskikh nauk

Cervical ribs. Khirurgiia no.4:83-84 Ap '54.   (MLRA 7:6)

1. Iz fakul'tetskoy khirurgicheskoy kliniki Dnepropetrovskogo
meditsinskogo instituta.
              (RIBS, abnormalities,   (ABNORMALITIES
                 *cervical ribs)   *ribs, cervical)

KHRISTICH, A.D.: Dotsent

Homoplastic transplantation of extremities in dogs. Khirurgiia
no.4:59-62 Ap '55.   (MLRA 8:9)

1. Kafedra gospital'noy khirurgii (zav.-prof. T.Ye. Gnilorybov)
Dnepropetrovskogo meditsinskogo instituta (dir.-dotsent D.P.
Chukhriyenko)
        (TRANSPLANTATION,
            extremities, homoplastic in dogs)
        (EXTREMITIES, transplantation,
            homoplastic, in dogs)

BULGARIA / General Problems of Pathology. Transplanta- U
tion of Tissue and Tissue Therapy.

Abs Jour: Ref Zhur-Biol., No 11, 1958, 51573.

Author : Khristich, A. D.
Inst   : Dnepropetrovsk Medical Institute.
Title   : On Transplantation of Extremities in Dogs.

Orig Pub: Sb. nauchn. rabot. Dnepropetrovsk med. in-t,
1956, 2, 237-239.

Abstract: No abstract.

Card 1/1

22

USSR/Human and Animal Physiology. Blood Circulation.   T
Blood Vessels.

Abs Jour: Ref Zhur-Biol., No 20, 1958, 93265.

Author : Khristich, A.D.
Inst   :
Title   : The Problem of Homoplastic Arteries (Experimental and
Clinical Investigation)

Orig Pub: Khirurgiya, 1956, No 9, 25-29.

Abstract: Special screw fasteners were applied to dogs under
aseptic conditions, and the vessel was cut (femoral
artery or abdominal aorta). Arterial transplants
1 - 1.5 cm long, obtained from live or dead dogs
(at different intervals after death), were sutured
to the central and peripheral ends of the cut vessel.
In the first 3 - 5 days after operation degenerative

Card   : 1/2

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KHRISTICH, A.D., dotsent

Immediate and late results of autoplastic transplantation of the
extremities in dogs. Ortop.travm. i protez. 17 no.6:141 N-D '56.
(MIRA 10:2)

1. Iz kafedry gospital'noy khirurgii (zaveduyushchiy - professor
T.Ye.Gnilorybov) Dnepropetrovskogo meditsinskogo instituta
(direktor - dotsent D.P.Chukhriyenko)
       (EXTREMITIES (ANATOMY)--TRANSPLANTATION)

KHRISTICH, A. D. (Lessik), Doc of Med Sci -- (diss) "Blood supply and innervation of the vascular seam, transplant, and soft tissue of a transplanted limb (experimental investigation)." Moscow, 1957, 20 pp (Central Institute for the Advanced Training of Physicians), 200 copies (KL, 32-57, 96)

S

USSR/Human and Animal Morphology - (Normal and Pathological)
        Cardiovascular System.

Abs Jour   : Ref Zhur Biol., No 6, 1959, 26152

Author   : Khristich, A.D.
Inst   :
Title   : Blood Supply of Auto - and Homotransplants of Venous
           Wall. II.

Orig Pub : Novy khirurg. arkhiv, 1957, No 1, 65-70

Abstract : In order to investigate the dynamics of blood supply res-
toration in a section of venous trunk in auto - and homo-
transplantation, 20 surgeries of such vein transplanta-
tions were performed on dogs. Large veins were utilized:
jugular and femoral. In 8 experiments auto-plasty was
performed, in 12- homoplasty. 6 times from 2-140 days
after surgery histological investigations of veins from
the zones of anastomoses, according to the method of Prof.
B.V. Ognev with application of India ink, were performed.

Card 1/3   *khar of clinical anatomy and - 29 - operative surgery*
                               AMS USSR.

S

In specimens prepared during the first days after surge-
ry of transplantation in the zone of sutures with 3-5 mm
in width there were empty avascular areas which were more
expressed in sutures made with clamps than with thread.
In the following early days these avascular zones narro-
wed up to 0.5-1 mm. At the ends of the autotransplant
and receiving vein, tortuous ends of trunkated vasa va-
sorum with clavate and conic endings bordered on these
empty zones. Later, a thick small-meshed network of
vessels was observed here which filled the zone of the
suture sometimes up to complete black areas. Finally,
in later times, after 60-140 days, in the zone of sutu-
res anastomoses were observed between the vessels of the
transplant and receiving vein similar, even if somewhat
smaller, development of a vascular network was observed
at corresponding times in homotransplantation of veins.

Card 2/3

USSR / Human and Animal Morphology (Normal and Patho-   S-4
      logical).   Nervous System.

Abs Jour: Ref Zhur-Biol., No 17, 1958, 79075.

Author : Khristich, A. D.
Inst   : Not given.
Title   : Innervation of a Vascular Autograft.

Orig Pub: Sb. nauchn. tr. Dnepropetr. med. in-ta, 1957,
      3, 276-281.

Abstract: Experiments on 17 dogs involved the abdominal
      aorta (3), femoral artery (3) and the general
      carotid artery (11). A venous autotransplant
      (A) was used in 7 cases, an arterial autotrans-
      plant in 10. Length of A was 1.5-2 cm. It
      was shown full disinnervation of A does not set
      in, owing to the presence in its wall of local
      centers of innervation in the form of gangli-

Card 1/2

22

KHRISTICH, A.D., dots. (Dnepropetrovsk , ul. Chekistov, d.3-a)

Blood supply and innervation of the vascular scar, transplant and
soft tissue of a transplanted extremity; experimental study.
Vest.khir. 81 no.10:23-31 O'58   (MIRA 11:11)

1. Iz kliniki gospital'noy khirurgii (zav. - prof. T.Ye. Gnilorybov)
Dnepropetrovskogo meditsinskogo instituta, kafedry klinicheskoy
anatomii i operativnoy khirurgii (zav. - prof. B.V. Ognev) i
kafedry gistologii i embriologii (zav. - prof. N.I Zazybin)
TSentral'nogo instituta usovershenstvovaniya vrachey.
              (EXTREMITIES, transpl.
                    blood supply & innerv. of vasc. scar, transplant
                    & soft tissue in dogs (Rus))

KHRISTICH, A.D., dotsent

Blood vessels of the soft tissue of reimplanted extremities in dogs.
Ortop.,travm.i protez. 20 no.11:42-51 N '59.   (MIRA 13:4)

1. Iz kafedry gospital'noy khirurgii (zaveduyushchiy - zasluzhennyy
deyatel' nauki USSR prof. Y.Ye. Gnilorybov) Dnepropetrovskogo medi-
tsinskogo instituta i kafedry klinicheskoy anatomii i operativnoy
khirurgii (zaveduyushchiy - chlen-korrespondent AMN SSSR prof. B.V.
Ognev) TSentral'nogo instituta usovershenstvovaniya vrachey.
          (TRANSPLANTATION exper.)
          (EXTREMITIES transpl.)

KHRISTICH (LESSIK), Agaf'ya Dmitriyevna; SIMONYAN, K.S., red.; BLISEYEVA, A.V., red.; BEL'CHIKOVA, Yu.B., tekhn.red.

[Innervation and blood supply of transplanted vessels and extremities] Innervatsiia i krovosnabzhenie peresazhennykh sosudov i konechnostei. Moskva, Gos.izd-vo med.lit-ry, Medgiz, 1960. 144 p. (MIRA 14:1)
    (BLOOD VESSELS--TRANSPLANTATION)
    (EXTREMITIES (ANATOMY)--TRANSPLANTATION)

SKRIPNICHENKO, D.F., prof., red.; SHURINOK, A.R., prof., red.;
     GABAY, A.V., prof., red.; DMITRIYEV, M.L., prof., red.;
     KHRISTICH, A.D., prof., red.; ZAYCHENKO, I.L., prof., red.;
     SITKOVSKIY, N.B., kand. med. nauk, red.; PARKHOMENKO, V.N.,
     red.

     [Problems in pediatric surgery; transactions] Problemy khi-
     rurgii detskogo vozrasta; trudy.   Kiev, Gosmedizdat USSR,
     1963.   257 p.   (MIRA 17:5)

     1. Ukrainskaya nauchno-prakticheskaya konferentsiya khirurgov
     detskogo vozrasta. 1st.

KHRISTICH, A.D., prof. (Dnepropetrovsk 10, ul. Chekistov, d.3-a)
KATONIN, K.I.

Regeneration of femoral bone tissue following transplantation
of an extremity; preliminary report. Ortop. travm. i protez.
24 no.2:18-21 F'63.   (MIRA 16:10)

1. Iz kafedry khirurgii detskogo vozrasta s detskoy orto-
pediyey (zav. - prof. A.D.Khristich) Dnepropetrovskogo me-
ditsinskogo instituta (rektor - doktor meditsinskikh nauk
N.Ya. Khoroshmanenko).

KHRISTICH, A.D., prof.

Resistance of the staphylococcus to antibiotics and charac-
teristics of the course of suppurative infections in children.
Khirurgiia 40 no.2:24-29 F '64.   (MIRA 17:7)

1. Klinika detskoy khirurgii (zav. - prof. A.D. Khristich)
Dnepropetrovskogo meditsinskogo instituta.

KHRISTICH, A.D., prof.; GORGIYEV, T.B. (Dnepropetrovsk, ul. Kuybysheva, d.6, kv.3)

Autovaccines in the treatment of septic conditions in children. Vest. Khir. 91. no.10:96-99 O '63.   (MIRA 17:7)

1. Iz kliniki detskoy khirurgii (zav. - prof. A.D. Khristich) Dnepropetrovskogo meditsinskogo instituta (rektor - prof. N. Ya. Khoroshmanenko).

ZUBENKO, P.M.; KHRISTICH, A.D.; LUKASHEVICH, K.F.; MANZON, S.M.;
     NOVIKOVA, A.A.; SHCHESNO, T.Yu.; ZUBENKO, I.P.

Biochemical changes in the muscles in dogs following the amputation
and replantation of an extremity. Trudy 1-go MMI 42:135-141 '65.
(MIRA 19:2)

1. Kafedra biokhimii i khirurgii detskogo vozrasta Dnepropetrovskogo
meditsinskogo instituta.

ACC. NR: AM6026909   (A)   SOURCE CODE: UR/0299/66/000/007/M037/M037

AUTHOR: Zubonko, P. M.; Khristich, A. D.; Lukashovich, K. F.; Manzon, S. M.;
Novikova, A. A.; Shchosno, T. Yu.; Zubonko, I. P.

TITLE: Biochemical changes in muscles of dogs following amputation and replantation
of an extremity

SOURCE: Ref. zh. Biologiya, Part II, Abs. 9M232

REF SOURCE: Tr. 1-go Mosk. Med. in-ta, v. 42, 1965, 135-141

TOPIC TAGS: dog, tissue transplant, muscle physiology, desoxyribonucleic acid,
ribonucleic acid, phosphorylation, organic phosphorus compound

ABSTRACT: Extremities of dogs were amputated and kept at room temperature for 1 to
2 hrs or on ice for 2 to 24 hrs. In 1 to 2 hrs nitrogen as well as phosphorus
metabolism disorders appeared in the muscles. Phosphocreatine and ATP levels decreased
significantly, and inorganic phosphorus and water soluble protein levels increased
without affecting fraction ratios during the first hour; in 2 hrs the myogen level
decreased. Changes of phosphorus compound levels were similar in extremities kept on
ice for 2 hrs; levels of water soluble proteins and their myogenic fraction increased
and their phosphorylase fraction decreased. Twenty-four hour cooling led to the same
changes. Phosphocreatine and ATP were almost completely broken down. Nucleic acid

Card 1/2

UDC: 577.99

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